Application No.: 10/801,981
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Remarks/Arguments

Claims 1-26 are in the application. Claims 1, 6, 9, and 21 are in independent form.

Objections of the Claims

Claims 11 and 12 have been corrected to recite "10^{-3} Torr."

The Examiner states that the wording "electrically isolated from one another" is grammatically incorrect. Applicants respectfully traverse. Webster's New World College Dictionary, 3rd Ed, (1997), p 946 defines "one another" as "each one the other; each other: see EACH OTHER (at EACH)."

"Each other" is defined as "each one the other; one another [we help each other]. Some speakers use each other only of two individuals and one another only of more than two, but in common use no distinction is made." Id. at 425.

Applicants submit that "one another" is not grammatically incorrect.

Claim Rejections – 35 USC § 112

Claim 13 is amended to remove the word "type."

Claim Rejections – 35 USC § 102

Claims 1 and 2 stand rejected under 35 USC 102(b) as anticipated by U.S. Pat. No. 6,184,525 to van der Mast ("van der Mast"). Claims 1-9, 17, 18, 21, 22, and 24 stand rejected under 35 USC 102(b) as anticipated by U.S. Pat. No. 5,396,067 to Suzuki ("Suzuki").

In a conventional environmental scanning electron microscope, the work piece (also referred to as the "sample" or "specimen") is surrounded by a gas. Secondary electrons emitted from the work piece by the impact of the primary electron beam are accelerated toward a detector electrode plate. On their way to the detector, the electrons collide with the gas molecules, ionizing them and creating more free electrons and ions in a cascade of collisions. The electrons are eventually collected by the detector electrode and the detected current is amplified. The gas typically occupies the space between the sample and the detector to provide amplification as the secondary electrons move from the sample to the detector.

Because the gas molecules interfere with the primary electron beam, the electron beam

path through the electron optics in the electron column is separated from the work piece chamber by a pressure limiting aperture. This keeps most of the gas in the work piece chamber, so that the pressure in the work piece chamber between the sample and the detector is sufficiently high to provide gas amplification, while the pressure in most of the electron column is sufficiently low to keep interference with the primary beam to an acceptable level.

This is the basic system describe by the cited references. Van der Mast improves the gas amplification though the use of magnetic and electric fields to lengthen the electron path, thereby creating more collisions. Suzuki reduces electrical charging of the work piece by providing an additional electrode for absorbing positive ions that are created in the collisions and that can charge the sample. Both references immerse the sample in a gas atmosphere to permit gas amplification. Van der Mast states that "the specimen is arranged in an atmosphere of gas at a pressure between 0.01 Torr (~1.3 N/m2) and 20 Torr (~2630 N/m2)." Col. 1, lines 65-67. Suzuki states "gas pressure in the sample chamber 2 is kept on the order of 0.1 Torr to several 10s of Torr."

Claim 1, on the other hand, recites maintaining "the pressure of the detector gas around the detector sufficient to operate the detector, while maintaining the pressure in the work piece vacuum chamber at a significantly lower pressure." That is, the pressure in the work piece vacuum chamber, i.e., around the sample, is significantly lower than the pressure around the detector. The references do not teach maintaining the pressure in the work piece vacuum chamber at a lower pressure. They both teach maintaining a high pressure around the sample. The portions cited by the Examiner show, not a lower pressure around the sample, but a lower pressure in the optical column, which is conventional for an ESEM, and is not what is claimed.

In particular, the Examiner states that van der Mast teaches "the charged particle beam including an (inherent) passage for delivery of the detector gas to maintain the pressure of the detector gas around the detector sufficient to operate the detector, while maintaining the pressure in the work piece vacuum chamber 2 at a significantly lower pressure, as recited in Col. 1/ll. 65-67 and Col.ll./ 1-2."

Applicants respectfully disagree. Vacuum chamber 2 is the electron column chamber and not the "work piece vacuum chamber." The sample 14 is not in the chamber 2. The chamber in which the sample is located is at a higher pressure. As described in col. 1, line 65 to col. 2, line 2, cited by the Examiner, "the specimen is arranged in an atmosphere of gas at a pressure between 0.01 Torr (~1.3 N/m2) and 20 Torr (~2630 N/m2)." As described in col. 2, lines 12-15, "[t]he gas surrounding the specimen thus acts as an amplifier for the secondary electron current . . . ." FIGS. 2 and 3 show ESEMs using gas amplification and show that the detector is in the work piece sample chamber and is at the same pressure as the work piece. Thus, van der Mast does not teach maintaining the pressure in the work piece vacuum chamber lower than the pressure at the detector. While FIG. 1 shows a detector 24 within the objective lens, the detector is not described as using gas amplification and skilled persons will recognize that the system of FIG. 1 does not use gas amplification, because the detector is not separated from the electron optical column by a pressure limiting aperture. FIG. 1 does not show the invention, but shows a conventional SEM in which the invention as shown in the remaining figures, can be used. Col. 4, lines 43-45, and col. 4, lines 34 to col. 5, line 13. Regardless, FIG. 1 does not show "the pressure of the detector gas around the detector sufficient to operate the detector, while maintaining the pressure in the work piece vacuum chamber at a significantly lower pressure."

The Examiner states that Suzuki maintains the pressure in the work piece vacuum chamber at a significantly lower pressure than the pressure around the detector, citing col. 5, ll. 14-19. Applicants respectfully disagree.

In col. 5, lines 14-19, Suzuki states that the gas pressure in the electron column (vacuum chamber 1) is lower that the pressure in the sample chamber 2, which, as described above, is conventional for an ESEM and not what is claimed. The detector in all embodiments of Suzuki is at the same pressure as the sample, except in the embodiment of FIG. 5, in which the pressure at the detector is lower, not higher, than the pressure in the sample chamber.

Applicants submit that claim 2 is patentable for the reasons described above with respect to claim 1.

Regarding claim 3, the examiner states that Suzuki's detector comprises two plates 19-10 in FIG. 2 and 22-10 in FIG. 5. Applicants respectfully disagree. Plate 19 is an ion collector, not a detector. Suzuki states: "The secondary electrons are then captured by the secondary electron detector 10 while being gas amplified. In this embodiment also, the positive ions are absorbed by the ion collector 19. A charge-up of the sample 7 to the positive potential is thereby prevented." Col. 6, lines 55-60. Ion collector 10 is not connected to an amplifier and there is no indication that any signal from it is collected and used. Its purpose is to prevent charging of the sample, not to provide a signal. The "ion collector 22" of FIG. 5 is also used to prevent charging of the sample and not for detection. Col. 8, line 58- col. 9, line 6. Thus, Suzuki does not teach a detector comprises two plates.

Regarding claim 4, applicants submit Suzuki does not teach passing a gas between two detector plates because, as described with respect to claim 3, Suzuki does not teach two detector plates.

Regarding claim 5, the Examiner states: "Suzuki's apparatus comprises a nozzle 26 directing gas toward a region between detector plate 10 and work piece 7, as shown in FIG. 7 and recited in Col. 9/ll 33-38." Applicants submit that fine tube 26 is not a nozzle directing gas toward a region between detector plate 10 and work piece 7. Fine tube 26 is an extension of pressure limiting aperture 3a. The gas, which is in sample chamber 2 leaks through fine tube 26 into the column vacuum chamber 1, and is removed by a vacuum pump to maintain a low pressure in vacuum chamber 1. Col. 9, lines 44-50. Thus fine tube 26 is not a nozzle directing gas to a region between detector plate 10 and work piece 7, but is a leak path for gas out of that region.

Regarding claim 6, the Examiner states that Suzuki includes a "work piece vacuum chamber 2b" and then says Suzuki includes "an ion generator 2b." The claim recites: "the chamber connected to the work piece vacuum chamber though an aperture." Suzuki's chamber 2b cannot be both the work piece vacuum chamber and the ion generator and connected to each other through an aperture.

The other item described by the Examiner as an ion generator is fine tube 26 of Fig. 6. Fine tube 26 is not an ion generator for neutralizing the work piece. Quite the opposite: fine tube 26 absorbs excess ions. Col. 10, lines 40-44. Ions are generated in work piece chamber 2 as the secondary electrons move from the sample 7 to the detector electrode 10, and an excess of positive ions can charge the sample. Col. 10, lines 29-37. The passages cited by the Examiner to show that fine tube 26 is an ion generator, "Col. 5/ll.46-52 + 60-68, more specifically in Col. 6/ll.4-9 and Col.2/ll.6-24 + 16-19, the latter referring to FIG. 9." refer to embodiments 1 and 9, which do not include fine tube 26.

Regarding claim 9, the Examiner states that Suzuki teaches "a lower pressure being maintained in the background chamber 1 shown in Fig. 5 and Fig. 6." Claim 9 recites "a work piece vacuum chamber for containing a work piece and having a background chamber pressure." Thus, the "background chamber pressure" is a pressure associated with the work piece vacuum chamber. Chamber 1 in FIGS. 5 and 6 is the electron optical column, and not the work piece chamber. In all of Suzuki's embodiments, the column 1 pressure is much lower than the sample chamber pressure. Col. 5, lines 14-19. The work piece chamber 2b in FIG. 5 is at a higher pressure than either chamber 2a or column 1. Col. 8, lines 49-52. Similarly, work piece chamber 2 in FIG. 6 is at a higher pressure than column chamber 1. Thus, Suzuki does not teach that the "ion producing gas is maintained at a sufficiently high pressure at the ion generator to produce sufficient ions from the secondary or backscattered particles to neutralize charge accumulation on the work piece, while the background chamber pressure remains at a significantly lower pressure."

Regarding claim 21, in the rejection, the Examiner's rejection does not identify in the reference an ion generator having "a body having rear and forward ends and a gas inlet opening to be controllably supplied with a gas, the forward end having an aperture opening to receive the secondary electrons and to emit positively charged ions."

Also, the Examiner states that fine tube 26 is both a gas supply and a channel electrode. As described above with respect to claim 5, fine tube 26 does not supply gas to an ion generator.

Fine tube 26 is also not "a channel electrode mounted within the body between the detector electrode and the aperture opening to channel the secondary electrons toward the detector electrode." Suzuki describes that the secondary electrons are "drawn toward the secondary electron detector 10 because of an electric field produced by the secondary electron detector 10." Col 10, lines 26-28. Fine tube 26 does not channel electrons and electrons that traveled in fine tube 26 would be prevented by the geometry from reaching detector 10. The purpose of fine tube 26, which is grounded (FIG. 6 and 7), is to shelter the primary beam from the gas in chamber 2, and to absorb ions, not to channel electrons. Col. 10, lines 3-19.

With regard to claim 18, applicants submit that it is not anticipated for reasons described with respect to its parent claim 9 and with respect to claim 21.

Regarding claims 7 and 17, the Examiner states FIG. 7 shows an "ion generator is positioned such that a line drawn from the center of the aperture to the intersection of the optical axis with the work piece is not parallel to the optical axis." In FIG. 7, ions would be generated in the work piece chamber 2. Thus, there is no aperture between the ion generator and the work piece and it is unclear how the Examiner is reading these claims on the reference.

Claim Rejections – 35 USC § 103

Claims 10-12, 20, 23, and 26 stand rejected under 35 USC § 103(a) for obviousness over Suzuki. Applicants submit that claims 10-12, 20, 23, and 26 are patentable for the reasons described above with respect to their parent claims.

Moreover, regarding claims 10-12, the Examiner states that the claimed pressures would have been obvious. Suzuki does not teach a work piece chamber gas pressure that is smaller than the ion producing gas pressure. The pressure in the Suzuki's sample chamber is the highest pressure in his systems. The ion producing gas is in Suzuki's sample chamber, although in FIG. 5, Suzuki also provides a second chamber, with the second chamber having a lower pressure than the work piece chamber. Thus, there is no suggestion to have a background pressure in the sample chamber that is lower than the ion producing gas pressure.

Regarding claim 23, applicants submit that fine tube 26 is not a "channel electrode" for

reasons described above. Moreover, applicants submit that the conical shape serves a purpose of channeling electrode from an aperture to a larger plate detector.

Claims 13-16 and 26 stand rejected for obviousness over Suzuki in view of van der Mast. The Examiner states that Suzuki shows all the limitation of claim 13-16 as previously applied to independent claims 9 and 21, except for additional limitation of the dependent claims. Applicants submit that these claims are patentable for the reasons describe above with respect to claim 9 and 21, and that neither Suzuki nor van der Mast shows the limitation of claims 9 and 21.

Moreover regarding claim 16, the Examiner states that "Suzuki's CPB apparatus includes a passage for transporting the ion producing gas, as recited in Col. 3/ll/35-53, more specifically in Col.3/ll/44-45." The cited lines state that the work piece chamber is supplied with a gas, but does not indicate that the particle detector includes gas passage.

Applicants respectfully requests reconsideration and allowance of the application.

Respectfully submitted,

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By: _____

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